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Range of Adaptation of Certain Varieties of Vegetable-Type Soybeans

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Range of Adaptation of Certain Varieties of Vegetable-Type Soybeans

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A FEW OBSERVATIONS on the range of adaptation of vegetable-type soybeans were included in Bulletin 453 of this Station, "Eighteen Varieties of Edible Soybeans," published in March, 1939. These observations were based on reports received from persons to whom seed had been distributed during the years 1935 to 1938 inclusive. The publication of this bulletin and press announcements regarding it contributed to the manifestation of a widespread interest in vegetable-type soybeans and resulted in the receiving of requests for seed from every state in the Union except two. There were also requests from five Canadian provinces and six foreign countries other than Canada. Persons living in 90 of the 102 Illinois counties requested seed.

In response to these requests a total of 1,880 lots of seed were sent out from Urbana; 216 requests from the southern states were referred to W. J. Morse, of the U. S. Department of Agriculture, Washington, D. C., who had seed of varieties presumably better adapted to the South.

The seed furnished most of these correspondents consisted of four packets, each containing approximately 100 seeds. Four varieties were represented, covering the season from early to late so far as possible with the seed available and with due consideration to the climatic conditions in the different parts of the country to which the seed was sent.

Three different assortments of varieties were used for the most part in the distribution.

Collection A, consisting of Giant Green, Bansei, Fuji and Willomi, was distributed to persons in northern Illinois and in all states where the climate is presumably as cool as or cooler than in that section of Illinois.

Collection B, consisting of No. 80494, Jogun, Illington and Imperial, was distributed in central Illinois and in most parts of Indiana, Ohio, Pennsylvania, and Nebraska, as well as in Connecticut and New Jersey.

Collection C, consisting of Giant Green, No. 80490-1, Emperor and Higan, was distributed in southern Illinois and in states presumably with similar or warmer climates. Only a few lots of seed were sent from Urbana into the distinctly southern states, since shortly after the distribution was begun, arrangements were made with Dr. Morse to take care of the southern requests.

Since available seed supplies were exhausted as of May 31, and the most favorable planting season was over, the 80 persons whose requests were received during June and July were sent no seed.

On September 1 a form for making a written report was mailed to each person to whom seed had been supplied, together with a letter asking that a report be made even if success had not been attained in the production of the crop.

Replies were received from 810 (43 percent) of the 1,880 persons who were supplied with seed from Urbana. Of the 630 Illinois residents receiving seed, 232 sent in reports; of the 1,225 persons in other states who were sent seed, 566 filed reports.¹ Twelve reports were received from foreign countries, to which 25 lots of seed had been sent.

Counties in the United States from which successful culture of vegetable-type soybeans was reported are shown in Fig. 2, page 83.

RANGE OF SUCCESSFUL CULTURE IN ILLINOIS

Reports received from 80 Illinois counties indicate successful culture of vegetable-type soybeans in 75 of those counties in 1939 (Fig. 1). Of the 232 Illinois growers reporting their experiences with

TABLE 1.—ILLINOIS REPORTS ON PLANTING OF VEGETABLE-TYPE SOYBEANS, 1939

	Number	Percent*
Persons to whom seed was sent.....	630	.....
Persons who sent in written reports.....	232	36.8
Persons reporting successful culture.....	184	79.3
Persons not planting seed received.....	13	5.6
Counties to which seed was sent.....	90	.....
Counties from which reports were received.....	80	.....
Counties reporting successful culture.....	75	.....
Persons reporting crop failure.....	35	15.1
Reported causes of failure.....		
Planted too late.....	6	17.1
Destroyed by rabbits.....	21	60.0
Weather too wet or too dry.....	3	8.6
Grasshoppers.....	1	2.8
Rootworms.....	1	2.8
Domestic animals.....	2	5.7
Cyclone.....	1	2.8
Growers who reported liking table quality of the soybeans.....	142	77.1
Growers who considered crop promising for their localities.....	131	71.2
Growers who saved seed for next season's planting.....	136	73.9

*Note different bases from which percentages are calculated.

¹All except 19 of these reports have been used in making up the summaries included in Tables 2 to 6 inclusive. Those not included were isolated reports from southern states, or from persons who did not receive the regular assortment of varieties distributed in a given state.

this new crop, 184 were successful in its production. The counties in which the soybeans were successfully produced were well distributed over the state, 17 being in the northern district, 32 in the central district, and 26 in the southern district, according to the horticultural divisions of the state designated by the Illinois State Horticultural Society.

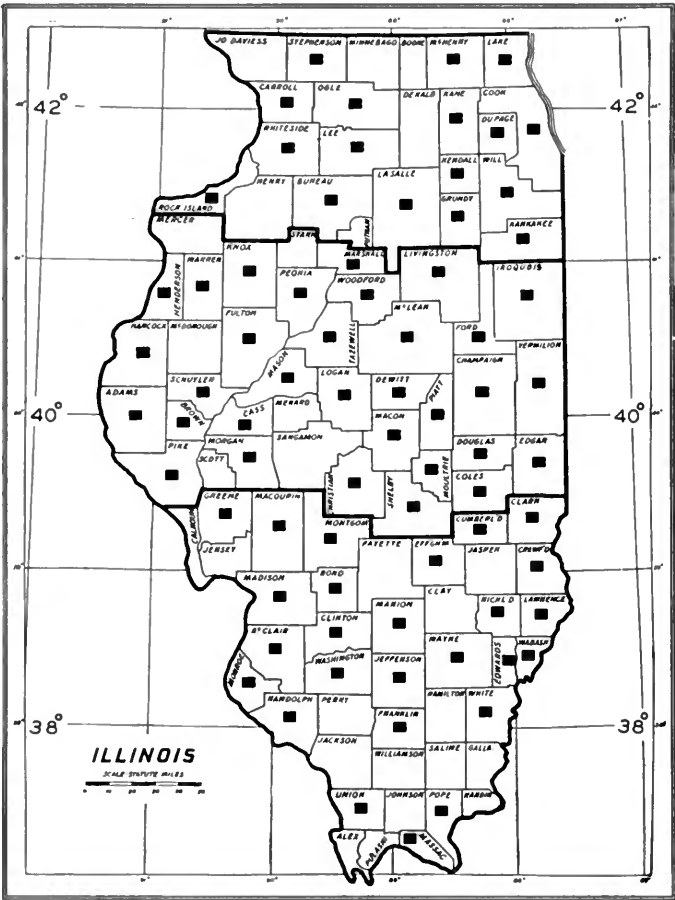


FIG. 1.—ILLINOIS COUNTIES FROM WHICH SUCCESSFUL CULTURE OF VEGETABLE-TYPE SOYBEANS IN 1939 WAS REPORTED

Destruction by rabbits was the chief cause of failure of the crop, the only other important cause being too late planting (Table 1). Twenty-one of the 35 failures were caused by rabbits alone. Rabbits

thus accounted for 60 percent of the failures. Damage by rabbits was reported by 43 growers besides the 21 whose crops were destroyed, making a total of 64 reports of damage by rabbits. The reports of damage by rabbits came from 38 different counties. Enemies other than rabbits were reported by only 32 of the 232 Illinois growers who sent in written reports. These enemies included grasshoppers (the most common), Mexican bean beetles, blister beetles, leaf hoppers, aphids, root worms, foliage diseases, moles, rats, mice, and domestic animals. In only four instances were the crops destroyed by any of these enemies; in fact, the damage was usually slight.

Correspondents were requested to state which varieties produced good yields. Good yields of all four varieties in a given collection were secured by 96 of the growers. Many growers mentioned one variety as outstanding in yield. It is interesting to note that in the majority of cases one of the early varieties was mentioned as the best yielder. Giant Green, which was included in the assortments of seed sent to northern and to southern Illinois, was reported as the best-yielding variety by a number of persons in both these areas. In the southern part of the state it was able to make its principal growth before the advent of excessively hot weather, and in the north part of the state there was plenty of time for it to mature well in advance of the usual frost date.

Bansei, which was also included in the assortment of seed sent to northern Illinois, was mentioned as the highest-yielding variety in various northern counties. No. 80494 was the earliest variety distributed in central Illinois and was mentioned by a number of growers as the highest in yield in that region. This variety and Bansei are quite similar in type.

The other variety besides Giant Green which yielded especially well in the southern part of the state was Higan, which is a late variety but which seems able to withstand the heat of that region.

Of the 184 Illinois growers reporting success in the production of the vegetable-type soybeans, 142 (77.1 percent) stated that they liked the table quality of these soybeans as a green vegetable. Several others said that they did not test the soybeans in the green stage, but were enthusiastic about their table quality as a mature bean. One hundred thirty-one Illinois growers (71.2 percent) stated that they considered the vegetable-type soybean a promising crop for their respective localities. The interest of 136 (73.9 percent) of the growers in this new vegetable was attested by the fact they were saving seed from their 1939 crop for the next season's planting.

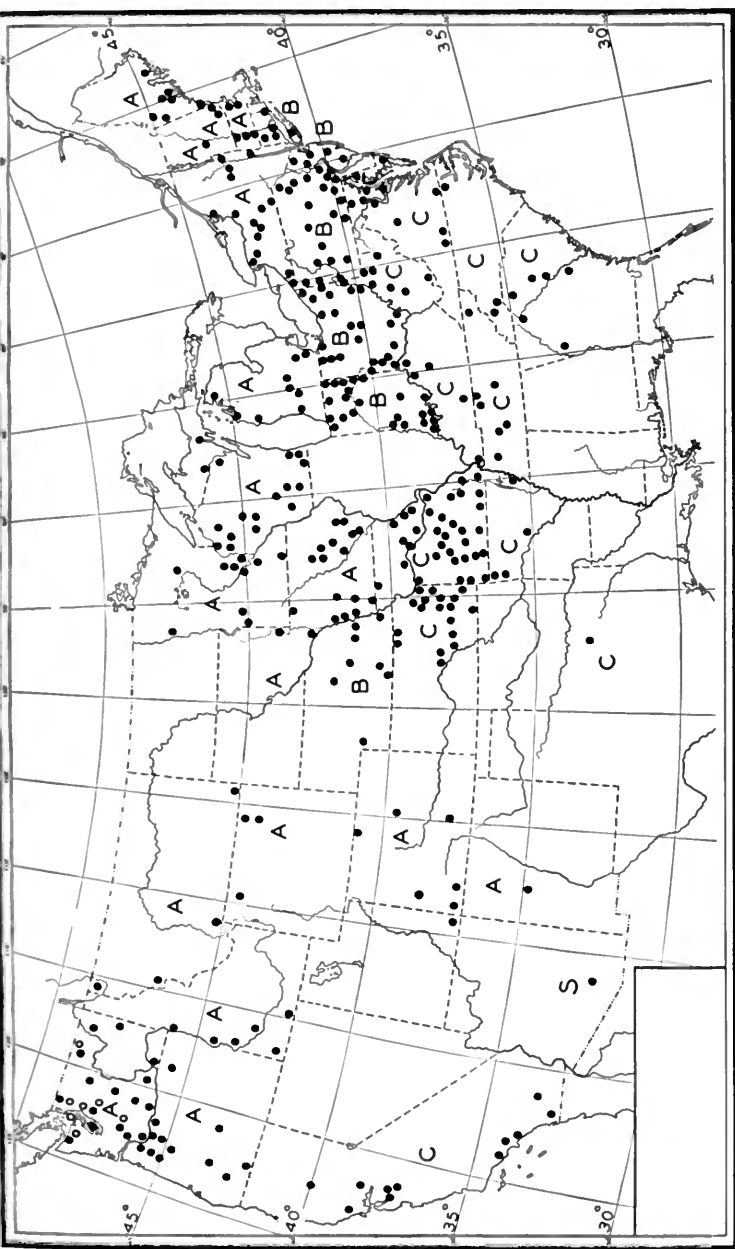


FIG. 2.—AREAS REPORTING SUCCESSFUL GROWTH OF VEGETABLE-TYPE SOYBEANS

Each dot represents a county from which successful culture of one or more varieties of vegetable-type soybeans was reported. **A** represents the A collection of seeds, **B** the B collection, **C** the C collection, and **S** (in Arizona) a selection from the A, B, and C collections. In the state of Washington the open circles indicate counties where failures were attributed to long-continued cool weather. (For Illinois counties from which successful culture was reported see Fig. 1, page 81.)

SUCCESSFUL CULTURE IN COOL CLIMATES

Seed Collection A, which consisted of one very early, two early and one midseason variety, was distributed in 19 states (other than Illinois) where the summer season is presumably as cool as it is in northern Illinois or cooler. The same collection was likewise distributed to a few persons in certain localities in three other states.

The performance of the vegetable-type soybeans in the cool-climate states in 1939 was very gratifying. Of the 265 persons in states other than Illinois reporting on their experiences in the growing of the varieties included in Collection A, 218, or 82 percent, reported success in the production of the crop (Table 2). It is true that in several localities success was measured by bringing the soybeans to edible condition as green shell beans rather than to maturity as a seed crop.

The outstanding adaptation of the Giant Green variety to relatively cool climates is strikingly brought out by the reports of its performance in these 19 states. In a number of localities, it was the only variety which matured seed, and in certain other localities it was the only variety to reach edible condition.

Upper Mississippi Valley and the Northwest

In the Upper Peninsula of Michigan and in Wisconsin, Giant Green matured seed at about 46° north latitude, and in Minnesota it matured in two counties north of 47°. In Oregon this variety matured seed in 12 counties, most of which were in the western part of the state. In Washington it matured seed in 16 counties widely distributed over the state. It was the only variety to reach maturity in many of the Washington counties. Furthermore, in certain localities, even in counties where some growers were successful with the crop, Giant Green, along with the other varieties, failed to develop a crop to edible maturity. This was particularly true in locations exposed to cool, moist winds from the Sound or the Ocean during the summer and fall.

Long-continued cool weather was assigned as the most prominent cause of failure of the soybean crop in Washington. In some instances the plants did not even bloom; in others, pods failed to develop. Counties in which certain growers reported crop failure on account of too cool weather are indicated on the map (Fig. 1). Successful culture in Okanogan county was at an altitude of 900 feet, and failure at 4,000 feet. It is worthy of note that the Giant Green matured seed in Okanogan, Stevens, Whatcom, and Clallam counties at latitudes above 48° north.

TABLE 2.—PERFORMANCE OF FOUR VARIETIES OF SOYBEANS IN COOL CLIMATES, 1939
(Collection A)

	Colo.	Idaho	Iowa	Maine	Mass.	Mich.	Minn.	Mo.	Nebr.	N. H.	N. Mex.	N. Y.	N. Dak.	Ore.	Pa.	S. Dak.	Utah	Vt.	Wash.	Wis.	Wyo.	Total	Percent	
Number of reports.....	10	11	18	9	9	28	17	4	8	5	3	4	29	2	24	6	7	2	2	39	23	5	265	....
Success with crop.....	6	8	17	8	6	25	14	4	5	4	3	4	26	1	24	6	3	2	1	26	22	3	218	82.2
Good yields, all varieties	1	1	7	3	5	10	8	3	1	2	2	..	18	1	4	3	1	1	..	2	7	1	81	....
Edible before frost																								
Giant Green.....	6	8	16	8	6	24	12	3	5	4	3	2	26	1	22	5	2	2	1	23	22	3	204	93.6
Banet.....	4	8	15	2	6	24	11	4	1	4	3	3	23	1	15	5	1	2	1	10	13	1	157	72.0
Fuji.....	4	8	15	2	6	24	11	3	1	4	3	2	23	1	16	3	1	2	1	10	13	1	157	72.0
Willom.....	5	8	15	3	6	22	10	4	1	4	3	3	24	1	15	5	2	2	1	14	15	1	164	75.2
Mature before frost																								
Giant Green.....	5	7	14	3	5	23	12	3	3	4	3	2	22	..	21	5	2	2	1	20	16	3	176	80.7
Banet.....	3	7	13	1	6	13	5	4	..	4	2	2	16	..	10	3	1	1	1	6	7	1	106	48.6
Fuji.....	3	7	12	1	4	10	4	3	..	4	2	1	16	..	9	2	1	1	1	6	7	1	95	43.5
Willom.....	4	7	12	1	4	11	1	4	..	4	2	2	16	..	11	4	2	1	1	7	6	1	101	46.3
Liked table quality.....	4	5	13	6	6	13	9	3	3	3	1	3	20	1	13	5	2	1	1	16	15	2	145	66.5
Considered promising.....	6	6	13	5	5	14	8	3	1	3	1	3	20	..	13	3	3	1	1	8	18	3	138	63.3
Saving seed.....	5	7	16	3	6	21	11	4	..	4	2	1	19	..	20	5	3	2	1	18	17	3	168	77.0
Reports of crop failure...	2	3	1	1	3	2	3	..	3	1	..	..	3	1	..	..	3	..	1	12	1	2	42	....
Causes of failure																								
Planted too late.....	1	3	..	..	2	..	..	..	2	..	..	..	..	..	..	..	1	..	2	..	..	3	....
Dry weather.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	10	....
Rabbits.....	..	..	..	..	..	1	1	..	..	..	..	2	1	..	..	..	..	..	..	..	..	7	....
Woodchucks.....	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	3	....
Deer.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	2	....
Birds.....	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	....
Grasshoppers.....	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	1	..	..	..	..	3	....
Weather too cool.....	..	..	..	1	..	..	1	..	1	..	..	..	..	..	..	..	..	..	8	..	2	13	....
Enemies noted																								
Rabbits.....	..	6	..	1	2	1	1	..	1	..	..	8	1	1	..	1	..	..	..	2	..	24	....
Woodchucks.....	..	..	..	1	1	1	..	..	..	..	..	2	..	..	..	..	..	1	1	1	..	6	....
Deer.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	..	4	....
Grasshoppers.....	1	1	1	1	..	4	..	..	2	..	1	1	1	1	..	1	..	1	..	..	13	....	
Cutworms.....	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	2	....	
Caterpillars.....	..	..	..	..	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1	....	
Mexican bean beetles.....	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	2	....	
Gophers.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	2	....	
Moles.....	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	2	..	3	....	
Wire worms.....	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	....	
Blister beetles.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	....
Did not plant seed.....	2	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	5	....

Collection A was sent to a few growers in the northern parts of Missouri, Nebraska, and Pennsylvania.

Results of Tests in New England

Along the Atlantic Coast, in Maine, Giant Green likewise seemed to be the only variety adapted to the rigorous conditions. In fact, reports of successful culture were centered largely on this variety; but even with this variety less than half the growers who reported good yields of green shell beans secured a crop of ripe seed. Most of the counties in Maine in which Giant Green developed to edible condition are located approximately at or above 44° north latitude.

In Massachusetts, New Hampshire, and Vermont—the other New England States in which Giant Green, Bansei, Fuji, and Willomi were distributed—all four varieties reached edible condition and in several places all four matured seed.

Performance in New York

Twenty-six growers in New York State reported success in the production of vegetable-type soybeans in 1939. These growers were located in fifteen different counties scattered from the Hudson River Valley on the east to Chautauqua county on the west, and from Long Island on the south to Jefferson county on the north.

In each of these fifteen counties all four varieties in Collection A matured seed crops. Good crops were procured quite generally by those reporting, in spite of extremely dry weather and attacks by rabbits. One grower reported:

“When about 6 weeks old, the plants were eaten off close to the ground by rabbits and woodchucks. They grew again four times but each time were eaten off. The Fuji plants grew very fast after the latest attack about August 20, and I am enclosing two samples of the beans produced on them plentifully in such a short time.”

This report was received October 20, and the beans were then in prime edible condition.

Results in Iowa and South Dakota

Seventeen growers in Iowa reported success in the production of vegetable-type soybeans in 1939. These reports were from 16 counties widely distributed over the state.

The four varieties in Collection A, Giant Green, Bansei, Fuji, and Willomi, thrived quite generally thruout Iowa, as indicated by these tests, tho Bansei was most frequently mentioned as producing high yields. There was considerable damage from rabbits, but in only one instance was the entire crop destroyed. One grower reported that the

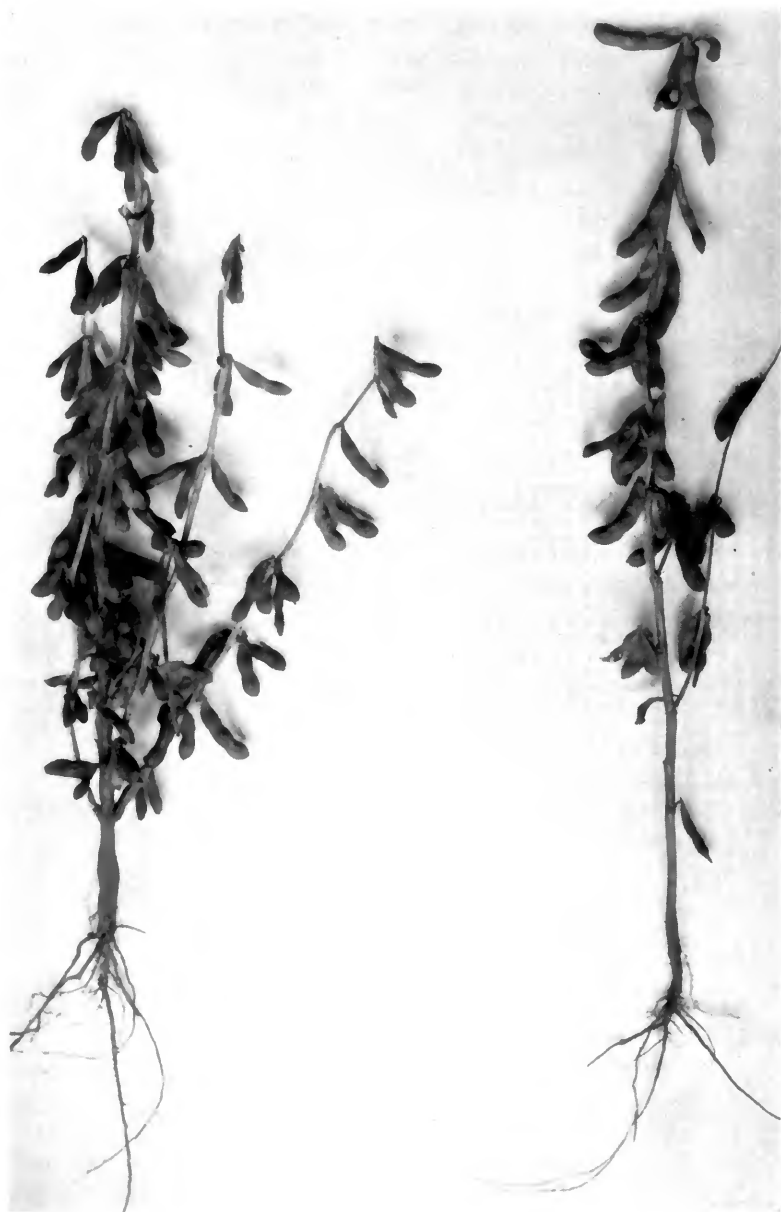


FIG. 3.—PLANTS OF THE GIANT GREEN VARIETY

This early variety matured in several northern localities where other varieties failed. Plant at left had ample room to develop; plant at right grew in a thick stand. (Photographed at Urbana, September 1, 1939.)

wild rabbits preferred the soybeans above all other vegetables in the garden; another mentioned that the rabbits seemed to have a preference for particular varieties, eating the young plants of Willomi most and Bansei least.

Rabbits, grasshoppers, and dry weather interfered seriously in the production of the vegetable-type soybeans in South Dakota, but all four varieties in Collection A matured good crops in Union and Moody counties, in the southeastern part of the state.

Performance at High Altitudes

In the mountainous state of Colorado all four varieties of Collection A matured seed in Denver county at an altitude of 5,200 feet and in LaPlata county at an altitude of 6,000 feet. Giant Green matured seed in Larimer county at 5,000 feet, in Delta county at 6,500 feet, and in Montezuma county at 7,000 feet. Bansei and Willomi matured seed in Huerfano county at 7,000 feet.

In Idaho all four varieties matured seed in Nez Perce county at an altitude of 1,700 feet, in Owyhee county at 2,000 feet, in Canyon and Washington counties at 2,400 feet, in Elmore county at 2,500 feet, and in Twin Falls county at 3,745 feet. In some of these locations the soybeans were irrigated and in others they were not. Reported failures of the crop in Idaho were due principally to dry weather in unirrigated locations.

In Montana the Giant Green matured seed in Carter county at an altitude of 3,000 feet and in Gallatin county at an altitude of 4,900 feet. It reached edible condition in Missoula county at 3,200 feet and in Lincoln county, at the extreme north edge of the state, at 1,800 feet. Lincoln county lies north of 48° north latitude. No other variety except Giant Green matured seed in the Montana tests reported.

All four varieties in Collection A matured seed in Johnson county, Wyoming, at an altitude of 3,750 feet. In Campbell county, at an altitude of 4,630 and in Park county at 4,600 feet, Giant Green was the only variety to mature a seed crop. The other three varieties blossomed and set pods but did not reach edible condition before the plants were killed by frost late in September. In Converse county, at an altitude of about one mile, the soybeans did not even blossom.

In San Juan county, Utah, at an altitude of 7,000 feet, the Giant Green, planted June 5, matured seed before the killing frost of autumn on October 5. In Valencia county, New Mexico, at an altitude of 8,000 feet, the Giant Green matured seed and the other three varieties of Collection A reached edible condition.

The feeling of growers in this group of cool-climate states toward the vegetable-type soybeans is indicated by the large number who reported that they liked the table quality of the green shell beans, that they considered the crop a promising one for their respective localities, and that they thought enough of the crop to go to the trouble of saving seed for the next season's planting (Table 2).

PERFORMANCE OF VARIETIES IN COLLECTION B

The vegetable-type soybeans constituting Collection B (No. 80494, Jogun, Illington and Imperial) were distributed to growers in Indiana, Ohio, Pennsylvania, New Jersey, Connecticut, and Nebraska, besides a few in Missouri. This was the collection also used in central Illinois, as previously mentioned.

Pronounced Success in Midwest and East

Indiana. The vegetable-type soybeans produced bountiful crops in Indiana in 1939, reports of successful culture being received from 23 counties, including three counties which were furnished seed other than Collection B.

TABLE 3.—PERFORMANCE OF FOUR SOYBEAN VARIETIES IN VARIOUS STATES, 1939 (Collection B)

	Conn.	Ind.	Mo.	Nebr.	N. J.	Ohio	Pa.	Total	Percent
Number of reports.....	5	25	5	15	12	29	35	126	....
Success with crop.....	5	21	4	4	9	21	27	91	72.2
Good yields									
80494.....	3	19	4	2	9	20	19	76	83.5
Jogun.....	2	16	4	3	8	18	20	71	78.0
Illington.....	2	14	4	4	7	15	17	63	69.2
Imperial.....	3	12	4	2	7	14	19	61	67.0
Liked table quality.....	3	15	3	2	7	14	20	64	70.3
Considered promising.....	3	15	4	3	5	18	18	66	72.5
Saving seed.....	2	18	2	3	8	20	23	76	83.5

In many localities in Indiana all the varieties planted did well, but the variety attracting most attention from the standpoint of yield was No. 80494. This variety was mentioned by 19 growers as producing good yields (Table 3), and was singled out as the highest-yielding variety in each of nine counties, some of which were in the extreme southern part of the state and others well to the north.

Rabbits and woodchucks interfered somewhat with the production of the soybeans in Indiana, and were responsible for three-fourths of

TABLE 4.—CAUSES OF CROP FAILURE, AND ENEMIES NOTED ATTACKING VEGETABLE-TYPE SOYBEANS IN CERTAIN STATES, 1939
(Collections B and C)

	Collection B							Collection C										Total Band C			
	Conn.	Ind.	Mo.	Nebr.	N. J.	Ohio	Pa.	Ark.	Calif.	Ga.	Kans.	Ky.	Md.	Mo.	N. C.	S. C.	Tenn.		Tex.	Va.	W. Va.
Reports of crop failure.....	..	4	1	10	2	7	8	2	3	..	11	1	1	1	5	..	1	1	1	..	58
Causes of failure																					
Planted too late.....	..	..	..	2	..	1	2	..	1	..	4	..	..	2	..	..	1	..	..	..	3
Dry weather.....	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	12
Wet weather.....	..	1	..	..	2	3	4	1	..	..	5	1	1	1	..	..	..	..	..	..	3
Rabbits.....	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	20
Woodchucks.....	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	3
Domestic animals.....	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Birds.....	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2
Grasshoppers.....	..	..	..	8	..	..	..	..	..	1	1	..	..	2	..	..	..	..	..	..	11
Negligence.....	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Alkali soil.....	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Enemies noted																					
Rabbits.....	1	4	1	2	3	5	8	1	1	..	15	..	3	13	..	..	3	..	2	..	61
Woodchucks.....	1	1	..	..	..	..	1	..	..	..	4	..	1	10	..	..	5	1	..	..	26
Grasshoppers.....	..	1	..	8	1	2	1	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Caterpillars.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17
Japanese beetles.....	2	..	..	..	6	6	9	..	..	..	..	..	..	..	..	..	1	..	3	5	27
Mexican bean beetles.....	1	4	..	..	1	..	6	..	..	..	..	1	..	..	..	..	1	..	..	..	2
Aphis.....	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Moles.....	..	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	..	2
Leafhoppers.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Blister beetles.....	..	..	..	..	..	..	..	1	..	..	6	..	..	2	..	..	..	..	..	..	8
Field mice.....	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	1	..	..	..	1
Rats.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Foliage diseases.....	..	..	..	..	..	..	..	..	1	..	..	..	..	2	..	..	..	..	..	..	3
Did not plant seed.....	..	..	..	1	1	1	..	..	5	..	3	..	..	..	..	..	1	..	..	..	12

the reported failures (Table 4). Dry weather did not seem to interfere with the crop in most Indiana localities. One grower in Harrison county, in the extreme southern part of the state, reported:

"Our season was so dry here that the usual beans failed to produce anywhere near a normal crop. I do not see how these soybeans could have produced more even if the weather had been more favorable."

A grower in Warrick county, also in the extreme southern part of the state, reported that he planted the soybeans June 15 as a second crop following garden peas, and that all varieties matured before killing frost, which was about November 1.

Ohio. In Ohio successful culture of the soybeans was reported from 23 counties, including 4 counties receiving seed other than Collection B. The counties were distributed over the state from north to south and east to west. A grower in Warren county reported:

"We planted them [the soybeans] right along side of other beans; the beetle [presumably Mexican bean beetle] completely destroyed the other beans and did not touch the soybeans."

The horticulturist in charge of a school garden in Cleveland reported:

"We were so well satisfied with the soybeans that we are going to use them on school gardens next year. On this tract of five acres 300 children will use them as an additional vegetable next year."

Pennsylvania. In Pennsylvania also successful culture of the soybeans was reported from 23 counties distributed well over the state from east to west and from north to south. Most of the reports were from growers who had planted the varieties contained in collection B, tho 3 counties were included to which other varieties had been sent. Altho the season was very dry in some localities, good yields were produced. Rabbits attacked the crop in many localities and were responsible for fully half the reported failures. Mexican bean beetles and Japanese beetles were mentioned by a number of growers, but in most cases no serious damage was done. Characteristic reports were:

"Bean beetles and Japanese beetles attacked the soybeans very mildly but ruined our limas and green beans."

"Japanese beetles seemed to like the foliage, but did no serious damage. Mexican bean beetles destroyed Henderson (bush lima) crop planted next to soybeans, while the soybeans showed little if any effect of their attack."

New Jersey. Nine growers in New Jersey reported success in the production of vegetable-type soybeans. Dry weather did not seem to affect the growth. Japanese beetles were reported as attacking the crop quite generally, but in no case reported was the crop destroyed by these insects.

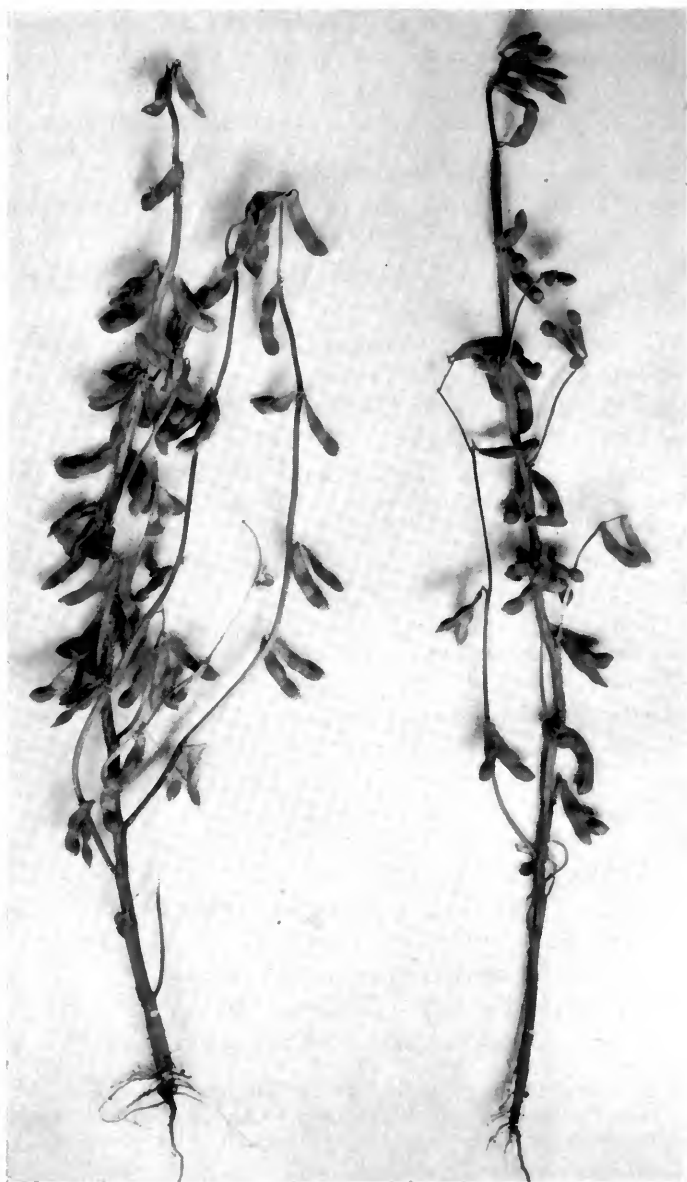


FIG. 4.—PLANTS OF THE BANSEI VARIETY

This variety has produced exceptionally well in northern Illinois, Iowa, and other localities with similar climates. It is said to be especially adapted to the manufacture of soybean milk, and has also proved a good canning variety. Plant at left had ample room to develop; plant at right grew in a thick stand. (Photographed at Urbana, September 12, 1939.)

Connecticut. Only five reports were received from Connecticut, but all these indicated successful production of the crop.

Trouble With Grasshoppers in Nebraska

Out on the plains of Nebraska grasshoppers and dry weather interfered very seriously with the production of the vegetable-type soybeans. Of 20 reports from this state only 8 indicated success with the crop (Tables 2 and 3). Counties in which the soybeans were successfully grown were chiefly in the eastern third of the state.

PERFORMANCE OF VARIETIES IN COLLECTION C

The varieties included in Collection C (Giant Green, No. 80490-1, Emperor, and Higan) were considered adapted to climates somewhat warmer than the corn belt, and were distributed in response to requests from Kansas, Missouri, Kentucky, Tennessee, Maryland, Virginia, West Virginia, and California. A few growers in Arkansas, Georgia, Texas, North Carolina, and South Carolina were also sent these varieties before arrangements were made for them to be furnished with more distinctly southern varieties.

Rabbits and Dry Weather Curtailed Kansas Crop

In Kansas reports of successful culture of the vegetable-type soybeans were received from a total of 18 counties. Most of these counties were in the eastern third of the state. Rabbits and dry weather were the principal causes of failure reported, including failure to plant the seed on account of insufficient moisture to secure germination (Table 4). Many growers reported good yields in spite of hot, dry weather (Table 5).

Giant Green performed especially well in Kansas, and in several instances was the heaviest yielder, by reason of reaching edible condition before the hottest weather arrived. The late variety, Higan, was reported the heaviest yielder in certain localities, tho in some other places it was said to have been affected by the dry weather and hot winds. Probably the difference was due to the stage of development of the beans in the different localities at the time the hot weather arrived. In general, Emperor seemed less able to thrive under Kansas conditions than the other three varieties.

The adaptation of the soybeans to even Kansas conditions is illustrated by certain comments of growers. A grower in Shawnee county reported:

TABLE 5.—PERFORMANCE OF FOUR SOYBEAN VARIETIES IN VARIOUS STATES, 1939
(Collection C)

Ark. Calif. Ga. Kans. Ky. Md. Mo. N.C. S.C. Tenn. Tex. Va. W.Va. Total Perct.															
Number of reports...	6	23	5	35	6	8	37	3	3	10	3	7	10	156	...
Success with crop....	4	15	5	21	5	7	32	3	3	8	2	6	10	121	77.5
Good yields															
Giant Green.....	3	7	3	15	5	7	24	2	2	8	2	4	5	87	71.0
80490-1.....	3	6	4	12	5	5	21	2	2	6	..	4	5	75	61.9
Emperor.....	2	7	3	8	5	6	23	2	2	4	..	5	5	72	59.5
Higan.....	2	8	4	13	5	6	26	2	2	5	1	6	6	86	71.0
Liked table quality..	4	6	..	14	3	7	20	2	1	6	1	4	4	72	59.5
Considered promising	3	5	3	11	3	7	23	2	2	5	1	5	5	75	61.9
Saving seed.....	3	7	3	19	5	7	24	2	2	6	1	5	6	90	74.4

"The soys stood the high temperature, up to 109° with strong south wind, in good shape. Planted May 6, Giant Green was picked for table use August 2."

A Wyandotte county grower made the comment:

"The soybeans are ready to eat when the dry weather has finished the string beans."

Successful Thruout Most of Missouri

Successful culture of vegetable-type soybeans was reported from 35 Missouri counties in 1939. These counties were well distributed over the central, eastern, and southern parts of the state but were not so numerous in the northwest portion.

The performance of the different varieties in Collection B in Missouri was quite similar to their performance in eastern Kansas. In several instances Giant Green produced the largest yield, while in other localities Higan was the most productive. Rabbits and grasshoppers were the most prominent enemies in Missouri, but only in a relatively small number of cases did they destroy the crop. Dry weather was a less severe handicap than in Kansas. One grower reported: "These soybeans made and matured their crop without any rain after planting." Another reported: "Soybeans outyielded all other crops in the garden." However, in some localities, pods on the late varieties dried up without maturing properly.

Central and Eastern States Bordering South

Only six reports were received from Kentucky, but five of these indicated successful production of all four varieties in Collection C. Three growers reported as follows:

"All varieties yielded enormously."

"I consider them a promising bean because we can hardly raise snap beans anymore on account of Mexican bean beetles. The season was dry and most garden crops were failures, yet the soybeans made fair crops."

"The season was very dry, with practically no rain for two months. We failed almost completely with string and lima beans but came thru with the soys."

In Tennessee, Giant Green was the most consistent producer. Higan yielded well in certain localities, but in others was severely affected by late drouth. Emperor seemed the least adapted of the four varieties to conditions in this state. One grower planted snap beans and soybeans side by side the same day. Mexican bean beetles "ruined the snap beans but did not bother the soybeans at all." One grower reported that he was planning to introduce soybeans on the Nashville produce market next year.

Very favorable reports of performance of the varieties in Collection C were received from Maryland. Giant Green was mentioned as most drouth-resistant. Mexican bean beetles were reported as abundant in the localities where the soybeans were grown, but doing no damage whatever to the soybeans.

All but one report from Virginia indicated success with the soybean crop. Higan was the most consistent producer. One grower commented, "The soybeans afford another fresh vegetable in September and October, when another fresh one is appreciated." From Madison county came the report, "I planted about May 1 in garden between snap beans and lima beans, and bean bugs [presumably Mexican bean beetles] ate up limas and snap beans, but did not bother the soybeans."

All reports received from West Virginia indicated success with the crop, tho not in all cases were large yields secured. However, one grower reported a yield of 645 seeds (363 pods) from one plant of the Emperor variety. The following comment came from Tyler county:

"Consider edible soys a blessing for poor rural population as they will never be destroyed by Mexican bean beetles altho they do attack them to some extent, and they will produce on poor hill land."

The Farm Security Administration, Morgantown, which had been furnished a quantity of soybean seed for distribution, reported as follows:

"The reports from families who tried the edible soybeans have been gratifying indeed. . . . We believe that in a short while soybeans for the table will be commonly grown thruout West Virginia."

Results of Tests in Southern States

Comparatively few samples of soybean seed were sent from Urbana to growers in North Carolina, South Carolina, Georgia, Arkansas, and

Texas. However, several reports indicating successful culture were received from these states, even tho the varieties sent (Collection C), with the possible exception of Higan, are not generally considered well adapted to southern conditions. Least success, compared with number of reports, was attained in Arkansas and Texas. Dry weather interfered with the crop in these two states, and rabbits also caused some trouble in Arkansas. However, especially good results were reported from Faulkner county, Arkansas, and Tarrant county, Texas.

From one North Carolina grower came the report:

"All varieties produced good yields, but the Emperor and Higan were more prolific than the others [Giant Green and No. 80490-1] and made a larger growth—about 24 inches high. Each matured in succession just right and the latest are getting dry now [September 10], two months before average first frost. . . . I believe they are almost a sure crop and fine to fall back on if others fail."

Another North Carolina grower said:

"In spite of late planting, poor location, dry weather and lack of care, they grew well and gave good yields."

One report from South Carolina said: "Giant Green did especially well." Another report from the same state said: "All did well, but Higan was ahead in yield."

From White county, in the highlands of northern Georgia, came the report: "They yielded wonderfully down here." Good yields from all four varieties were likewise secured in Meriwether and Jenkins counties, which are farther south and at much lower elevations.

Performance in California and Arizona

The vegetable-type soybeans were successfully grown in eleven California counties, distributed from Tehama on the north to San Diego on the south, and including both interior and coast regions, tho in some localities difficulty was experienced in growing the crop close to the ocean. For the most part, the crops were grown under irrigation.

One grower in Ventura county commented: "They [vegetable-type soybeans] are now our favorite vegetable for fall, and I only wish they were a year-round crop."

At the Agricultural Experiment Station at Tucson, Arizona, eight varieties of vegetable-type soybeans, selected from Collections A, B, and C, were grown under irrigation at an elevation of 2,400 feet. Planted June 12, all the varieties made satisfactory yields, Illington, No. 80490-1, and Emperor being especially prolific.

PERFORMANCE IN CANADA AND OTHER OUTLYING REGIONS

Tests of Early Varieties in Canada

At St. George, Ontario, Giant Green, Bansei, Fuji, and Willomi all matured seed before killing frost, which occurred October 21. All these varieties yielded good crops, but Bansei was the best producer.

At the Central Experimental Farm, Ottawa, where a number of varieties were tested, only Giant Green matured seed before frost, which occurred on September 24. The only other variety to reach edible maturity was No. 80494.

At Barrington Passage, Nova Scotia, Giant Green did not do well. Fuji was the only variety which produced pods before the frost on September 19.

At Bogot, Manitoba, 75 miles north of the international boundary, only Giant Green matured seed before the frost on September 25, tho Fuji had reached edible condition. "The Giant Green is apparently the only variety [of the four in Collection A] early enough for this locality."

At Swift Current, Saskatchewan, the season was evidently too cool for the soybeans. Altho planted May 4, "not any of the varieties had any beans on as yet," when the report was made September 29.

In British Columbia, Giant Green, Fuji, and Willomi reached edible condition in Sea Island county, but none matured seed, even tho killing frost did not occur until November 3. Heavy yields of Giant Green and Willomi were produced. At Westminster, in the same province, Giant Green matured a good crop of seed but was the only variety to reach edible condition. The other three varieties "were only just starting to form pods when the fall rains started and they began to shed their leaves."

Results in Three Remote Regions

An attempt was made to grow the vegetable-type soybeans at Grand Falls, Newfoundland (latitude approximately 49° north). Cold weather delayed planting until June. The plants made a luxuriant growth but had not yet blossomed when killed by frost on August 26.

Contrasted with the conditions in Newfoundland are those in Chihuahua, Mexico, where even at an elevation of 6,000 feet, the usual temperature in the sun gets as high as 120° F. during the late spring and summer months. The 1939 season was very dry as well as hot, and none of the varieties developed seed.

In Honolulu, Hawaii, all four varieties—Giant Green, 80490-1,

Emperor and Higan—yielded very well, tho the plants grew only 12 to 14 inches high.

ACCEPTABILITY OF VEGETABLE-TYPE SOYBEANS

Each person to whom seed was furnished was asked to report how he liked the soybeans served as a green vegetable, whether he considered them a promising vegetable for his locality, and whether he was saving seed for the next season's planting. It was thought that answers to these three questions would shed considerable light upon the acceptability of this vegetable from a personal standpoint and its adaptability to a given locality. Data by states on these three points are given in Tables 1 to 5. A summary is given in Table 6.

Nearly 70 percent of those who reported successful production of the soybeans stated that they liked them served as a green vegetable, and a great many were extremely enthusiastic about them. Some who did not have a very large crop refrained from eating any of the beans but saved them all for seed. This partly accounts for the fact that more people saved seed than reported that they liked the green beans. Some reserved judgment regarding adaptation to their respective localities pending further tests; hence the somewhat lower number of positive reports on this point. More than 78 percent of the growers reported that they were saving seed for subsequent planting.

DEMAND FOR SEED

Interest in the vegetable-type soybeans is further attested by the large number of requests for seed or information regarding seed sources received since the close of the 1939 season. Many reports

TABLE 6.—SUMMARY OF REPORTS ON VEGETABLE-TYPE SOYBEANS, SHOWING SUCCESS WITH CROP AND ATTITUDE OF GROWERS, 1939^a

	Number					Percentages					
	Ill.	Other states A B C			Total	Ill.	Other states A B C			Aver.	
Number of reports.....	232	265	126	156	779	.....	.....	.....	.....	.....
Success with crop.....	184	218	91	121	614	79.3	82.2	72.2	77.5	78.8	
Liked table quality.....	142	145	64	72	423	77.1	66.5	70.3	59.5	68.8	
Considered a promising crop.....	131	138	66	75	410	71.2	63.3	72.5	61.9	66.7	
Saved seed.....	136	168	76	90	470	73.9	77.0	83.5	74.4	76.5	

^aThe 12 reports from foreign countries are not included in this summary; neither are the 19 reports from isolated localities or those made on irregular assortments of seed. See footnote, page 80.

from those who received seed in the spring of 1939 were accompanied by requests regarding seed for 1940. Part of these were from persons who met with crop failure and desired to try again, part from those who liked the green beans so well that they ate them all, and part from those who saved *some* seed but desired more.

There were also many requests for information regarding seed sources from persons who had not previously been furnished seed but who had read about this new vegetable and desired to try it. It was found necessary to prepare a mimeographed sheet, listing varieties of vegetable-type soybean seed available for 1940 spring planting and firms prepared to supply them. This sheet was used in answering all inquiries regarding vegetable-type soybean seed during the spring of 1940.

PLACE IN VEGETABLE INDUSTRY

For *home gardens* in Illinois and other states with similar climates, the vegetable-type soybean is one of the most reliable of vegetables and can be depended upon to produce a crop even under rather adverse conditions except in localities where rabbits or grasshoppers are too abundant. Furthermore, the crop is available for use as a green vegetable at a season of the year when other garden crops on the farm are likely not to be abundant. By planting three or four varieties maturing at different times, a continuous supply of green shell beans can be had for a period of five or six weeks; in some seasons and some localities the period may be even longer.

For *commercial canning* in localities where green peas are regularly canned, and hence where equipment for shelling (vining) the green soybeans is available, the vegetable-type soybean constitutes an additional cannery crop available for processing at a season when the pea-canning equipment might otherwise be idle. In a few localities canning of the soybeans on a commercial basis has already been accomplished. The mature soybeans of the vegetable type also offer great possibilities for canning after soaking, the same as navy beans and red kidney beans are handled, and may eventually become a standard source of high-protein food.

Preservation of the green shell soybeans by the *quick freezing process* has been highly successful in an experimental way, and the product has been so satisfactory in color, texture, and flavor that this method of making the vegetable-type soybeans available for winter use holds much promise.

As a *stored dry bean* the vegetable-type soybean may be made avail-

able at any time during the winter, and constitutes a highly concentrated protein food. It serves the same purposes as the navy bean and is better adapted to production in certain localities than that bean.

Specialty products of many kinds are being manufactured from different varieties of the vegetable-type soybean; and as larger supplies of these soybeans become available, it is probable that such uses will be greatly extended.

The *chief complaints* that have been raised against the vegetable-type soybeans are the difficulty encountered in hand-shelling the green beans and the readiness with which the mature beans shatter from the pods. This contrast in shelling qualities of the green and the ripe beans presents a problem which challenges the ingenuity and skill of the plant breeder. A breeding program covering these and various other points of importance in the growing and using of vegetable-type soybeans was inaugurated at the Illinois Station in the spring of 1940.

SUMMARY

Reports received from 810 persons to whom samples of vegetable-type soybean seed were sent in the spring of 1939 indicate the wide range of adaptation of this new vegetable. Successful production was reported from Maine to the Pacific Coast, and from near sea level to an altitude of 8,000 feet.

Early varieties proved to be the best producers in most localities and were the only ones well-adapted to northern regions.

Rabbits were the most prevalent enemy of the crop, tho grasshoppers were serious in certain localities.

Dry weather interfered with the proper development of the crop in some places; but many reports indicate the ability of the vegetable-type soybean to withstand extreme drouth.

About 70 percent of the persons reporting success in the production of the crop were well pleased with the table quality of the soybeans.

This new vegetable is worthy of extensive trial.



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